Vision-Based Verification of Authentic JAKIM Halal Logo

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ABSTRACT

In Malaysia, the authenticity of halal logo has been a great concern to its Muslim community due to the existence of different types of halal logo in the market. Due to this situation, in this paper, a detection system was developed to classify the authentic Jabatan Kemajuan Islam Malaysia (JAKIM) halal logo from the unauthentic ones. All the distinct features from the authentic logo were used in the implementation part of this project with the intention of producing a reliable detection system. The methods that are chosen to be used are SURF, SIFT, GIST, and k-means. These methods can be said is reliable and practical as the resulted accuracy which was 86.6667 was quite high.

Keywords: halal, logo, JAKIM, authentic

I. INTRODUCTION

In Islam, similar to the other religions, there are teachings that are needed to be adhered to by its people. One of the practices involved is the need of monitoring dietary laws. Muslims have restriction in which they can only consume lawful (halal) foods and are prohibited to take the unlawful (haram).

As a matter of fact, in today's world, there are about 1.6 billion Muslims which have made up over 23% of today's world population. Therefore, to cope with the people of this world's second largest religion, specifically in their dietary restriction, many organizations have involved with the implementation of halal certificate on various type of products before the products being sell in the market. In Malaysia, specifically, Muslim happens to be the dominant group among its plural society. That is why this country through its Islamic body, Jabatan Kemajuan Islam Malaysia (JAKIM), has introduced its own halal logo years ago.

The halal logo acts as a certificate that authorized the lawfulness of the products available in the market. The implementation of this type of certificate has benefitted Muslim consumers as it makes them feel confident in consuming products that displaying the logo which acts as the evidence of the lawfulness of the product. Indeed, the availability of the halal logo has become the consumer's biggest concern and is one of the factors that allow products to be able to penetrate successfully into the market.

Due to these reason, nowadays there are some illegal and fake logo being made. Therefore, halal logo detection is a must as failure of Muslims to adhere to this Islamic practice of halal and haram will lead to bad consequences to themselves. In addition, as halal logo from Jakim is made up of several features, its authenticity can be proved with the help of reliable application of computer vision in distinguishing the authentic logo with the fake and illegal ones.

II. OBJECTIVES

- To detect authentic JAKIM halal logo.
- To produce a high accuracy detection of JAKIM halal logo.

III. LITERATURE REVIEW

A. Role of Halal Awareness and Certification

In recognizing the lawful products, Malaysia in 2004 has introduced its standard of halal which does not only involving food but also contains guidelines with are related to the process transporting, packaging, labeling and transportation process of foods in order to make sure their conformity with the halal standards and concessions [1]. In the research done by Aziz and Vui (2012), two of their proposed hypotheses which are:

i. The intention of purchasing is positively dependent on the halal awareness.
ii. The intention to purchase is positively dependent on the halal certification

have been found to be supported with their empirical research. These results have proved that the halal products do attract more consumers and as halal logo is the easiest way to recognize the halal status of the product, practical method to differentiate the authentic logo with the fake ones is very important.

B. Features of Halal Logo by JAKIM

Fig-1: Halal Logo by JAKIM [10]

- Eight cusp star which is located on the inner area of the two big circles;
- Word حلال which is a halal word in Arabic alphabets that is located on the inside of the eight cusp star;
- "HALAL" word which is written with Roman characters is located just below the Arabic word of halal;
- Word "Malaysia" from the Roman characters as well as in Arabic characters (ماليزيـــا) are located in between the two big circle of this identification;
- As a separation point of "Malaysia" words in Roman and Arabic characters, two small five cusp stars are being used in between these two words. [10]

C. *Related Works*

1. Radio Frequency Identification Based Verification Mechanism of Halal Food

Nasir, Norman, Fauzi and Azmi (2011) had used automatic identification in their project as they claimed that the process of securing halal certificate is not easy for consumers. As Radio Frequency Identification (RFID) has been found has higher operation, competency, defense as well as commercial essence, their project was expected to be able to aid consumers in validating the halal status on any products in the market. RFID contains three components namely tag reader and associated middleware. The tag used in this project was enrolled with special identification character which was being profiled to respective product data in the selected directory. The database used by this system is similar to database of Islamic authority in Malaysia. [2]

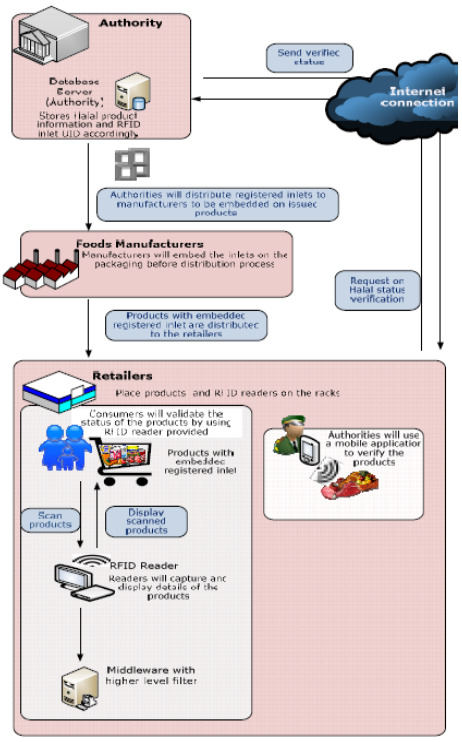

Fig-2: Process in Halal Validation System (Nasir, Norman, Fauzi, and Azmi, 2011)

Besides, as passive tags are cheaper than active tags, this project has selected passive tags as part of the components in their system. Therefore, just by scanning the tags of the products, the halal validation can be checked easily by the consumers themselves. With this method, complicated procedures to obtain the halal logo on products can be skipped by the product's manufacturers and as long as their productions comply with the halal standards, consumers can validate the lawfulness just by scanning the tag available on the products.

2. Halal Logo Detection and Recognition System

According to Norzali, Helmy, and Amir (2008), there are numbers of immoral businessperson used fake logo of halal on their commodity. That is why these researchers came up with the project called halal logo detection and recognition system. There are four main phases in this system. It starts with image acquisition, followed by image pre-processing, detection module and lasts with recognition module. Symbol extraction and edge detection are being used to build section of the image. The characteristics of the authorized halal logo are inspected to recognize the probable objects.

When the probable objects are found, the objects will be clipped from the background, being normalized to a certain size, and then be sent to the next stage which is a recognition stage. This stage mainly is related to the designated authorization in neural network. The input of the designated neural network is the enhanced images of the potential objects. Then in the recognition part, the result will be out which determines whether the logo is legal or not [3].

Fig-3: Examples of Unauthorized Halal Logo (Norzali, Helmy, and Amir, 2008)

3. Road Sign Detection and Recognition

In this research, Shneier (2005) has proposed a system that is capable in the detection of road signs by implementing regulations that inhibit color and shape. The system requires the sign to be visible only in limited portion in the image and similar to Norzali, Helmy, and Amir (2008), he was using template matching method in the recognition phase in which the tracking process will be completed through image sequential. Some of advantages of this system are related to its fastness and its ability to be modified to include more divisions of signs.

As RGB colors has been proven to be well-functioning and do not in need of color space alteration, tailored ratios of RGB colors are used to differentiate the sign classes. He also work on the frame of the signs to be the mask in the stage called sign realization stage. Characteristics of all the features are being calculated which includes the centroid and area. Besides, a set of regulations are being practiced whether to acquire or forfeit each blob as a clue nominee. If a blob is seen in five successive frames, it is secured as an applicant and will go into the phase of recognition of the algorithm which comprised of the template matching technique. [4]

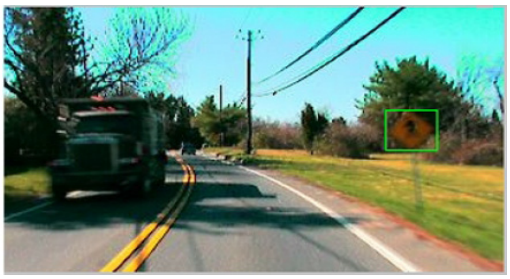

Fig-4: An Example of Frame with a Detected Sign from the Video (Shneier, 2005)

Fig-5: An Example of Binary image of warning signs, with the clear visibility of the shape of the sign (Shneier, 2005)

4. Detection of Traffic Sign

Similar to Shneier (2005), Garcia, Sotelo, and Gorostiza (2003) also proposed a system for sign detection. However, their system is specifically meant for offline traffic sign detection and they were implementing the Matlab Image Processing toolbox. The vision based traffic sign detection module developed by them can manage 172 x 352 color images in RGB format. There are several steps in the algorithm process. The first step is to obtain the inclination image region by accumulating its horizontal and vertical edge projection. Then, in the second stage, the obtained image region will be validated. The validation procedures of the candidates in the algorithm of this project are as follows:

i. Red image inception for prohibition sign.
ii. Blue image inception for obligation sign.
iii. Analysis of Blob shape.
iv. Template of Circular ring. [5]

5. Matching of Logo Matching for the Retrieval of Document Image

Zhu and Doermann (2009) have stated that in the process of recognizing and dividing free-form graphical arrangement like logos is quite demanding. The difficulties can come from large variations in logo style and also from a low quality images. Complex matters such as the lead content of pages basically include a combination of machine printed text, diagram and others. From the view of the application, specific localization is important in determining the symbol. Therefore, the design of logo detector must be able to steadily recognize and extract full symbols while trying to reduce rate of wrong detection.

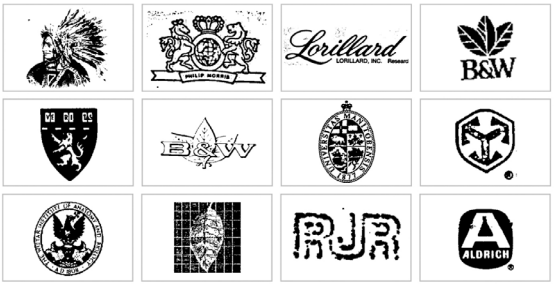

Fig-6: Example of identified and divided symbols from the image database (Zhu and Doermann, 2009)

These two researchers treated symbol as a non-solid pattern, and represented it with a digital set of 2D character marks selected from the target. 2D mark characters provide some benefits compared to the other geometrical figures that works in pattern portrayal as it helps the rigid hypothesis which is related to the topology and the temporal order of characters that are well-conserved under the alterations and degeneration of the figure. For example, the same part of the partition in one symbol may overlap while separately appeared in the other situations. By representing a segmentation of 2D point, a shape will be more reliable under the image noise and degenerations, while bringing digital form of data of the shape.

Two state of matching algorithms for logo test can be used. The primary scheme is mainly on the model of template behaviors. The spatial histogram is defined as a template context that is computed for each index which shows the segmentation of the corresponding point of all the remaining positions. With the relation of the matching process, the relations between positions are being solved at first through the weighted bipartite matching of graph. Last but not least, this method also used the neighborhood graph matching algorithm which making used of the shape matching as a maximization case that conserves the local features. [6]

6. Fast Symbol Identification and Realization in Document Image

With the aim of having division-free and frame-independent in logo detection and recognition, Li, Austum, and Neschen (2010) have introduced system architecture with a novel way to detect document images which is similar to the purpose of the research done in [6]. In the stage of training in this project, only one particular of each symbol is needed. The specific portion of this model is selected in the document image. The characters in this specific portion are excerpted and will be saved in a directory together with the normalized image of the symbol. Then during the training stage, the model characters will be developed which shows that the similar characters configured by different model are saved once only. All the characters are guided in a hyper-cubic formation which makes the searching and matching process becomes fast.

Firstly, all characters on the target figure are concentrated in the indentification and realization stage. Next, they will be matched to the characters in the directory. The output matches are involving not-wrong characters that are matched to the existing symbol of the model as well as the mismatches characters. Then, in order to identify and test the steadily of the pair wise distances between characters candidates that the same symbol model are matched, a system namely lines of anchor is being introduced. Lastly, validation process will be proceeding by using the normalized figure in the bounding box together with the saved model figure and comparing them to make sure the right matching. [7]

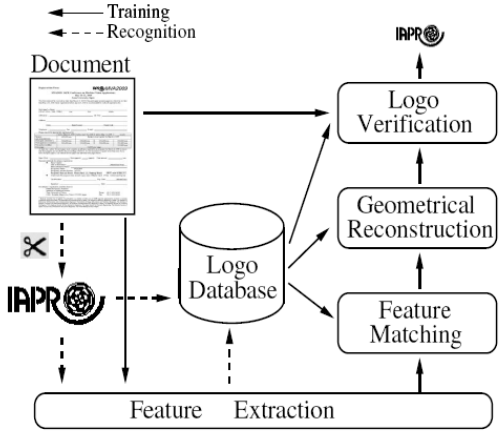

Fig-7: System Architecture of Logo Identification and Recognization (Li, Austum, and Neschen , 2010)

7. Logo Identification and Recognition of Document

Wang (2010) has stated that the toughness of logo identification and realization primary lies on the reliability of the algorithm. The difficulty lies in the variety of symbols and degeneration. Furthermore, as documents can give different purposes, it makes the symbol appears in diversify behaviors. Thus, Wang has designed non-static identification of symbol and realization stage is executed in steps. For every step, real time decision is used to discover the intermediate output until the logo completely identified. In this way it is possible to combine the logo identification and realization as one interesting framework. [8]

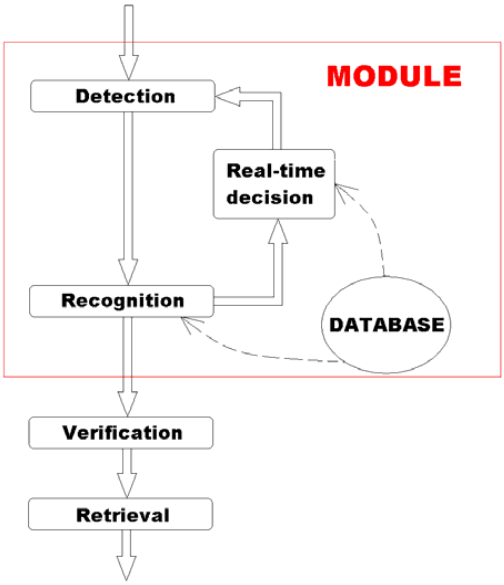

Fig-8: Adjusted symbol identification and realization framework. (Wang, 2010)

8. SIGMA

Xu, Yao, and Ji (2010) have introduced algorithm called Spatial InteGrated Matching Association (SIGMA). This algorithm is using spatial relationship of characters with the aim of showing associated problem of previous local characters method. Correlation prototype of every symbol division was being developed and by adding sequential process for the sequence of matching based on the spatial data, the matching process is optimized.

Besides, they also had proposed SIGMA for symbol identification in local situation that consists of extreme variety in perspectives and occlusions. This algorithm of SIGMA is comprised of two stages which are the Spatial InteGrated called SIG stage and the Matching Association, MA stage. Things SIG stage does is actually integrating the spatial relations that are portrayed by the character whereas stage of MA is meant for advancing the ability of matching by addressing the optimized sequence of matching. As a matter of evaluation procedure, by employing these spatial constraints, this system has showed good evaluations over all the access in logo detection with big margins. Hence, SIGMA algorithm actually has shown a more secured effectiveness in terms of the application of the matching association strategy. [9]

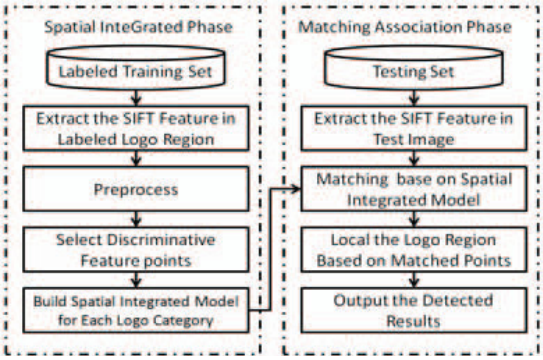

Fig-9: The sequence for SIGMA method. (Xu, Yao, and Ji, 2010)

9. Spatial Pyramid Mining

In the research done by Kleban, Xie and Ma, they had chosen their logo detection with the approach of association rules of data mining. This approach is able to seizure the usual structure in spatial domain of regional Scaled-Invariant Feature Transform (SIFT) labels that have been quantized. Figure 10 below, for instance, illustrates character points that had been matched by applying this mining approach.

Fig-10: Detected example of logo detection by clustering regional characters with the approach of data mining. (Kleban, Xie, and Ma)

In this paper, specifically in the association rule mining, the discovery of usual class of items which makes the existence of the set of target objects can be inferred confidently was its primary goal. As a matter of fact, the purpose of using this mining method called pyramid mining is to realize the associated ruling commence in the deal directories for space and semi local spatial zone which when being put together surpass any individual settlement. [17] That is why Han and Fu (1995) have upgraded this approach by introducing the concept of multilevel mining of associated ruling. Differently, this approach is giving more attention on the application of the high-level output on order to know the ones in the lower profile. [18]

IV. METHODOLOGY

Based on previous researches done by others, there are many methods that we can choose to apply to detect authentic halal logo. In this project, SURF, SIFT, GIST, and k-means techniques are among the methods chosen to be applied.

SIFT (Scale –Invariant Feature Transform) involves four main steps in its algorithm. Firstly, scale-space extreme detection is used by filtering process. We have designed various alpha values to conduct Laplacian of Gaussian for the image. Next, key point localization is applied into image. By knowing specific the key point's location, we will get a better and accurate result by refining them. Besides that, Taylor series also is used in extension of scale area to get more specific and correct locations followed by orientation to each key point that we have assigned before to get the invariance to that image. After that, a neighborhood is selected around the key point location depending on the specific scale. By doing so we can calculate the gradient magnitude and direction in that region. Lastly, key points matching between two images are matched and compared by identifying their nearest neighbors. This image matching is done for all images that we have in our data to determine the accuracy.

SURF (Speeded up Robust Features) is a speeded-up version of SIFT. This SURF is used to increase the performance for both scale and location. Interest points are introduced here. Interest points are chosen at distinctive locations in the image, such as corners, blobs, and T-junctions. Like authentic halal logo, we use 100 interest points at logo which are mostly localized at corners and etc. Next, the neighborhoods of interest points are represented by a feature vector. Lastly, the descriptor vectors are matched between unsimilar images. There are two separated files that we have created to separate the training and testing images. Each file contains different images of halal logo which has been classified to be authentic and non-authentic halal logo. By doing so, we can check and identify the accuracy of the testing data.

Fig-11: Detection of Interest Points in a Grayscale Image using SURF

Before computing the GIST descriptor, it is very important to normalize the image size when calculating the image similarities. This step can be done by redesign the image size. LM gist function is introduced here which will crop and resize each of our images to match the specified size before calculating the gist descriptor. But the resizing working will not affect the terms ratio of the original image. So that the originality size of image is still constant after we resizing them. Usually, we crop the image at the center. Then the image will be resized since the cropped region preserves the original input image as much as possible. This step is done in order to train a lot of data to increase the accuracy since there is only one authentic halal logo. We had resize the logo to make our train data as many as we can. We also had adjusted the color and resolution of authentic halal logo by filtering them.

Last but not least, K-means Clustering Algorithm method is applied in this task to complete and finish this task well. K-means is a machine learning and data mining. Below is K-means formula that was used.

$$\arg\min_{\mathbf{S}} \sum_{i=1}^{k} \sum_{\mathbf{x}_j \in S_i} \|\mathbf{x}_j - \boldsymbol{\mu}_i\|^2 \quad (1)$$

K-means clustering aims to partition the n observations into k sets ($k \leq n$) $\mathbf{S} = \{S_1, S_2, S_3 \ldots, S_k\}$ since to minimize the within-cluster sum of squares; where $\boldsymbol{\mu}_i$ is the mean of points in S_i.

This algorithm is good because it can control a large numbers of tasks by determining relatively homogeneous groups of tasks based on selected features and characteristics. However, the numbers of clusters that are needed in the system need to be assigned.

To fulfill this task, two clusters are assigned to differentiate the halal logo whether it is authentic or non-authentic. One of the methods is selected to classify cases, either updating cluster centers iteratively or classifying only. In this project, it is chosen to classify the data because our cluster was made up of two classes only. So it will be easier and more efficient to classify them.

In short, to run the detection and recognition process, we apply four main stages:

a. Image Acquisition
b. Image Preprocessing
c. Detection Module
d. Recognition Module

The further explanation of each stage is written as follows:

a. Image Acquisition

A set of data that contains different images of halal logo are taken from internet. Then, the images were renamed and uploaded manually into our system.

b. Image pre-processing

In this stage, we have to design the system that can recognize JAKIM halal logo. At first we convert images to gray images to ensure that images will have the same absolute luminance. By using the spatial filter effect technique, most of the the halal logo could be detected by the system. Then we filtered them to get this objective achieved.

c. Detection Module

Features detection is introduced here to detect authentic and non-authentic JAKIM halal logo. The features are listed to ease the system for detection halal logo according to our system. For that we introduced canny edge detector to detect them. We also highlighted about RGB in this case. RGB image was created in MATLAB into three data array. We can define RGB as red, green, and blue colour components for each single pixel.

Fig-12: Canny Edge Detector on Authentic JAKIM Halal Logo

d. Recognition module

Lastly, recognition module was held by implement neural network. It was an effective and efficient platform theory to predict and know a situation if appropriate model design architecture and input data were available. Also back propagation network referred to the algorithm introduced in these types of neural networks.

V. RESULTS

There are 60 images for each authentic and non-authentic halal logo that are implemented in testing data together with 100 images for each authentic and non-authentic halal logo that are implemented in training data. By having both training and testing data, we can conduct our experiment to test the image to get results.

After running the system, the accuracy of image testing was found to be 86.6667%. The percentage of this accuracy is high and proves that we can apply our methods to detect and recognize the authentic JAKIM halal logo.

Fig-13: Original and Filtered JAKIM Halal Logo using Spatial Filter

(1) (2)

Fig-14: (1) Original Image Before Filter
(2) After using Spatial Filter

VI. CONCLUSION

Based on the results that we get from methods that we had mentioned earlier, both objectives in this project are achieved and 86.6667% has been found to be the accuracy for the system after we finished running the program. This accuracy proves that the methods used in this project are suitable in the process of detecting JAKIM halal logo and also can be developed in practical. However, this system can only determine the accuracy for the testing data that has been classified beforehand. As this system is not user friendly, further studies and researches are needed in order to improve the performance in detection halal logo with the aim to be practical for people to use.

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